# PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2001-085747
(43)Date of publication of application : 30.03.2001

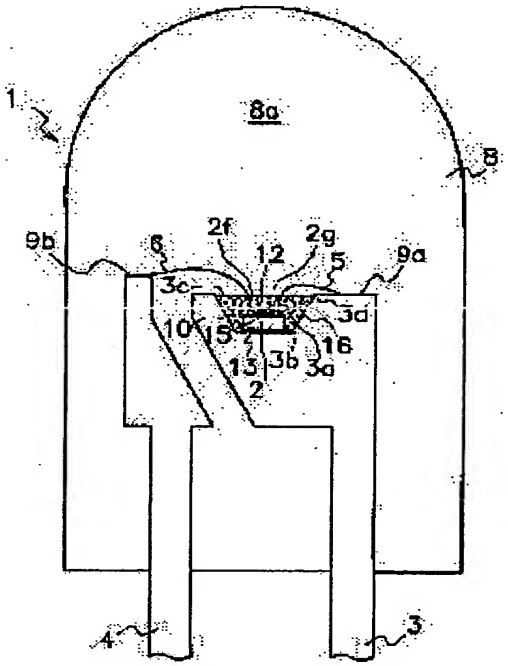
(51)Int.Cl. H01L 33/00
C09D 1/00
C09D 7/12
C09D201/00
C09J 11/00
C09J201/00
H01L 23/29
H01L 23/31

(21)Application number : 11-258381
(22)Date of filing : 13.09.1999

(71)Applicant : SANKEN ELECTRIC CO LTD
(72)Inventor : SANO TAKESHI
SHIRAISHI AKIRA

## (54) SEMICONDUCTOR LIGHT-EMITTING DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To prevent the generation of the uneveness in color of a semiconductor device.
SOLUTION: This semiconductor light-emitting device is provided with substrates 3 and 4, a semiconductor light-emitting element 2 fixed to a r c ss 3a formed at the substrates 3 and 4, coating materials 10 to be filled in the r cess 3a so that the semiconductor light-emitting element 2 can be coated, and a covering body 8 for covering the coating material 10. In this case, a translucent laminate 12, which includes fluorescent substances for conv rting the lights irradiated from the semiconductor light-emitting element 2 into the other emission wavelengths is fixed to the upper face or lower face of the semiconductor light-emitting element 2, and light-diffusing ag nt 16 for diffusing the lights irradiated from the semiconductor light-emitting element 2 is mixed with the coating materials 10. Thus, as a result light emission whose directivity is high can be obtained without color uneveness, and generation of cracks is suppressed.




LEGAL STATUS

| | |
|---|---|
| [Date of request for examination] | 13.09.1999 |
| [Date of sending the examiner's decision of rejection] | 07.01.2002 |
| [Kind of final disposal of application other than the xaminer's decision of rejection or application converted registration] | |
| [Date of final disposal for application] | |
| [Patent number] | |
| [Date of registration] | |
| [Number of appeal against examiner's decision of rejection] | 2002-01748 |
| [Date of requesting appeal against examiner's decision of rej ction] | 06.02.2002 |
| [Date f xtinction of right] | |

* NOTICES *



1. This document has b en translated by comput r.So the translation may not r flect the original precisely.
2. **** shows th word which can not b translat d.
3.In the drawings, any words are not translated.

---

CLAIMS

---

[Claim(s)]
[Claim 1] Base. The semiconductor light emitting device which fixed to the crevice formed in this base. The coating material with which covers this semiconductor light emitting device, and the aforementioned crevice is filled up. The covering obj ct which covers this coating material. It is semiconductor luminescence equipment equipped with the above, and the layered product of the translucency containing the fluorescent substance which changes into other luminescence wavelength the light irradiated from the aforementioned semiconductor light emitting device is fixed on the upper surface or the undersurface of the aforementioned semiconductor light emitting device, and it is characterized by mixing the light-scattering agent over which the light irradiated from the aforementioned semiconductor light emitting device is scattered into th aforementioned coating material.
[Claim 2] Semiconductor luminescence equipment according to claim 1 to which the crevice was formed in one edge of th xternal terminal of the couple which constitutes the aforementioned base, the aforementioned semiconductor light emitting devic fixed on the base of this crevice, and at least the electrode of the couple of this semiconductor light emitting device and on side of the external terminal of the aforementioned couple were electrically connected by the bonding wire.
[Claim 3] Semiconductor luminescence equipment according to claim 1 or 2 which covers the edge and bonding wire of th aforementioned coating material and an external terminal with the aforementioned covering object.
[Claim 4] The aforementioned light-scattering agent is semiconductor luminescence equipment given in any 1 term of the claims 1-3 which are the oxides, salts, or organic pigments containing one sort of silicon, aluminum, titanium, calcium, and barium, or two sorts or more.
[Claim 5] The aforementioned layered product is semiconductor luminescence equipment given in any 1 term of the claims 1-4 which fixed through the adhesives of a translucency to the principal plane of the aforementioned semiconductor light emitting device between the aforementioned semiconductor light emitting device and the aforementioned bases or by the opposite side of the aforementioned base.
[Claim 6] The aforementioned layered product is semiconductor luminescence equipment given in any 1 term of the claims 1-5 which absorb a part of light [ at least ] irradiated from the aforementioned semiconductor light emitting device, and mit the light of long wave length rather than this.
[Claim 7] The aforementioned layered product is semiconductor luminescence equipment given in any 1 term of the claims 1-6 containing the aforementioned fluorescent substance and a light-scattering agent.
[Claim 8] The aforementioned coating material is semiconductor luminescence equipment given in any 1 term of the claims 1-7 containing the aforementioned light-scattering agent and a fluorescent substance.
[Claim 9] The aforementioned coating material is semiconductor luminescence equipment given in any 1 term of the claims 1-8 which are the PORIME taro Korean geisha who has a translucency, a ceramic, or a resin.
[Claim 10] The aforementioned coating material is semiconductor luminescence equipment according to claim 9 which is glass formed considering METARO Korean geisha (metaloxane) combination as a subject.
[Claim 11] The aforementioned coating material is semiconductor luminescence equipment given in any 1 term of the claims 1-10 which it is formed under the surface layer in which the aforementioned light-scattering agent was mixed, and this surface layer, and the aforementioned light-scattering agent is not mixed, or are equipped with an internal layer with few contents of the aforementioned light-scattering agent than the aforementioned surface layer.
[Claim 12] It is semiconductor luminescence equipment according to claim 11 with which the aforementioned internal layer of the aforementioned coating material covers the whole surface except the inferior surface of tongue of the aforementioned semiconductor light emitting device, and the aforementioned surface layer covers the aforementioned s miconductor light emitting device through the aforementioned internal layer.
[Claim 13] The aforementioned semiconductor light emitting device or a layered product projects and bends from the upp r-limb section of the aforementioned crevice, and is semiconductor luminescence equipment given in any 1 term of claims 1-12.
[Claim 14] The aforementioned semiconductor light emitting device is semiconductor luminescence equipment given in any 1 t rm of the claims 1-13 which fix at the pars basilaris ossis occipitalis of the aforementioned crevice through the afor mentioned layered product and adhesives through the aforementioned adhesives.
[Claim 15] The aforem ntion d semiconductor light emitting d vic is semiconductor luminescenc quipm nt giv n in any 1 t rm of th claims 1-14 which mit light by 365-550nm light wav l ngth.
[Claim 16] The aforem ntion d semiconductor light emitting d vic is semiconductor lumin scence equipment giv n in any 1 t rm of th claims 1-15 which consist of a gallium-nitride syst m compound s miconduct r light emitting devic .
[Claim 17] Semic nduct r luminescenc quipm nt giv n in any 1 t rm of the claims 1-16 which fix th aforem ntion d semiconductor light emitting d vice at th pars basilaris ossis occipitalis of th aforem nti ned crevice through the fluor scence binder layer containing th fluor sc nt substanc which absorbs th light which it is mix d in th binder which has a translucency to th light irradiated from th aforem nti n d semiconductor light mitting device, and this bind r, and is irradiated from th aforemention d s mic nductor light emitting devic , and is chang d int other lumin sc nce wav l ngth.

[Claim 18] It is semiconductor luminesc nc equipment according to claim 1 which th crevice was form d in on principal plane of the insulating substrate which constitut s th af rem ntioned bas , and the afor mentioned semiconductor light mitting d vic fixed to this crevic , and was l ctrically conn ct d to the external terminal of a couple with which the l ctrode of th couple of th afor m ntion d s miconductor light emitting device is mutually prolonged in opposite direction along with one principal plan of th afor m ntioned insulating substrat .

---

[Translation done.]

*.NOTICES *



DETAILED DESCRIPTION

[D tailed Description of the Invention]
[0001]
[The t chnical field to which invention belongs] this invention belongs to the semiconductor luminescence equipment which is mad to carry out wavelength conversion and takes out luminescence from a semiconductor light emitting device to the equipment exterior with a fluorescent substance, and the semiconductor luminescence equipment which prevents an irr gular color in detail and can improve the directivity of light.
[0002]
[Description of the Prior Art] For example, the semiconductor luminescence equipment which emits outside the light of wavelength which the layered product containing a fluorescent substance is formed into the covering object (closure resin) which covers light emitting devices, such as a gallium-nitride system compound semiconductor, and the wavelength of th light emitted from a light emitting device is changed by the layered product, and is different is well-known.
[0003] Drawing 7 shows the cross section of the conventional light emitting diode equipment (20) which changes the wavelength of the light irradiated from a diode chip (2) with the fluorescent substance chip (12) of the layered product formed in the upper surface of a light emitting diode chip (2). With the light emitting diode equipment (20) shown in drawing 7 Th first external terminal as a cathode side lead with which a crevice (acetabuliform-like electrode) (3a) and the first wir connection (9a) were formed in one edge side (3), The second external terminal as an anode side lead with which th second wire connection (9b) was formed in one other edges side (4), The light emitting diode chip which fixed on the base (3b) of a crevice (3a) with adhesives (13) (2), The fluorescent substance chip which fixed through adhesives (15) on the upp r surface of a light emitting diode chip (2) (12), Between the cathode electrode (2g) and anode electrode (2f) which fixed for the light emitting diode chip (2), the first wire connection (9a), and the second wire connection (9b) It has the first bonding wire (5) connected electrically and the second bonding wire (6). Moreover, the crevice (3a) where the fluorescent substanc chip (12) and the light emitting diode chip (2) have been arranged, the edge of an external terminal (3 4), and a bonding wire (5 6) Since it is enclosed in the closure resin (8) of a translucency and has the lens section (8a) at the nos of cam of a closure resin (8), the light which passes through the inside of a closure resin (8) is condensed by the lens section (8a), and directivity is raised.
[0004] If voltage is impressed between the external terminals (3 4) of light emitting diode equipment (20) and it energizes for a light emitting diode chip (2), light will be irradiated from a light emitting diode chip (2). The light emitted to above [ of a light mitting diode chip (2) ] among the irradiated light reaches a fluorescent substance chip (12) through the adhesives (15) of a translucency, and after it turns into light of wavelength which wavelength conversion was carried out and is differ nt, it is emitted from a fluorescent substance chip (12). This light by which wavelength conversion was carried out is mix d with the light which it was emitted to the light and the longitudinal direction which were emitted to the longitudinal dir ction of a light emitting diode chip (2), and by which wavelength conversion is not carried out, and was reflected by th sid attachment wall (3c) of a crevice (3a) and by which wavelength conversion is not carried out, and is emitted to th exterior of light emitting diode equipment (20) through a closure resin (8).
[0005]
[Problem(s) to be Solved by the Invention] The mixed light of the light changed into luminescence wavelength for which th light mitting diode equipment (20) shown in drawing 7 is irradiated from a light emitting diode chip (2) as mentioned abov , and which is different through a fluorescent substance chip (12), and the light by which wavelength conversion is not carried out, without irradiating from a light emitting diode chip (2), and minding a fluorescent substance chip (12) is emitt d to th xterior of light emitting diode equipment (20). At this time, in fact, the light by which wavelength conversion was carri d out, and the light by which wavelength conversion is not carried out are not mixed completely, but an irregular color aris s in the light emitted outside, and a tint becomes an ununiformity.
[0006] Drawing 8 uses a gallium-nitride system (GaN) system blue light emitting diode chip (2) as a light emitting device, and shows typically the irregular color of the light emitting diode equipment (white light emitting diode) (20) which generates th whit light as a fluorescent substance using a YAG (yttrium aluminum garnet, chemical formula Y3aluminum 5O12) fluor sc nt substance chip (12). As shown in drawing 8 , with a fluorescent substance chip (12), wavelength conversion is fully carried out and the light emitted from the upper surface of a light emitting diode chip (2) is observed by the color near whit or yellow. On the other hand, the light emitted from the side of a light emitting diode chip (2) has the inadequate wavelength conv rsion by the fluoresc nt substanc chip (12), and is obs rved blue. For this r ason, seen from the upper part, as shown in drawing 9 , th irregular color of the light of the c nter yellow or liable to whit and the periphery of th shap of a ring liable t blu occurs.
[0007] Mor ov r, by mixing a light-scatt ring agent in th closur resin (8) of the aforementioned light mitting di de equipment (20), the light by which wav l ngth conversion was carried out, and the light by which wav l ngth c nv rsion is not carri d out can be mixed within a closure resin (8), and an irr gular color can be prev nt d. How v r, if a light-scattering agent is mixed in a closure resin (8), sinc th light mitted from th crevice (3a) will collid and reflect irr gularly n a light-scattering ag nt within a closur r sin (8), it is not compl t ly condens d in the lens section (8a) at the nos of cam of light mitting diode quipment (20), but the angl of b am spread f light b comes large, and dir ctivity falls.

[0008] this inv ntion aims at off ring th semiconductor lumin scenc quipment which pr v nts generating of an irregular col r. Mor ov r, it aims at off ring the s miconductor lumin sc nc quipment which raises the directivity of light. Moreov r, it aims at suppr ssing the crack initiation by th thermal xpansion of th coating material which covers a semiconductor light mitting d vic . Furth rmore, the str ss which joins a semiconductor light emitting d vic is reduc d, and it aims at pr venting degradation of a s miconductor light mitting d vic .
[0009]
[M ans for Solving th Problem] The s miconductor luminescence equipment by this invention is quipped with the covering object (8) which covers th coating mat rial (10) with which cov rs th semiconductor light mitting device (2) which fix d to th crevice (3a) formed in th base (3, 4, 11) and the bas (3, 4, 11), and a s miconductor light emitting d vice (2), and a crevice (3a) is filled up, and a coating material (10). The layered product (12) of the translucency containing the fluorescent substance which changes into other luminescence wavelength the light irradiated from the semiconductor light emitting device (2) is fixed on the upper surface or the undersurface of a semiconductor light emitting d vice (2), and the light-scattering agent (16) over which the light irradiated from the semiconductor light emitting devic (2) is scattered is mixed into a coating material (10).
[0010] Since deviate in the various directions by the light-scattering agent (16), the scattered light occurs in a crevice (3a), the scatt red light is mixed and it interferes mutually when the light irradiated from the semiconductor light emitting devic (2) passes through the inside of a layered product (12) and a coating material (10), the amount of luminescence is equaliz d over th whole luminescence side surface of a covering object (8). Moreover, in addition to dispersion of light, the light by which wavelength conversion was carried out and wavelength conversion was carried out further, and the light by which wavelength conversion is not carried out are mixed, and it interferes in the light which passes along the layered product (12) containing a fluorescent substance. for this reason, the light emitted to the coating-material (10) shell exterior — dispersion and wavelength conversion — and since it is mixed and interferes, the luminescent color is equalized over th whole luminescence side surface of a covering object (8) Thus, since the quantity of light and the luminescent color which are emitted from a covering object (8) are equalized, an irregular color can fully be suppressed. Since dispersion of light, wavelength conversion, mixture, and interference are performed in the crevice (3a) used as a reflecting plate and a lot of light reflects by the inside of a crevice (3a), the breadth of a light beam is suppressed, the quantity of light which goes to the crowning of a covering object (8) increases, and condensing nature and directivity can be improved. Furthermore, since a light-scattering agent (16) is mixed into a coating material (10), the coefficient of linear expansion of a coating material (10) approaches the coefficient of linear expansion of a semiconductor light emitting device (2). For this reason, the thermal expansion of the coating material (10) by generation of heat at the time of lighting of a semiconductor light emitting devic (2) and the coating material (10) by the coefficient-of-linear-expansion difference with a semiconductor light emitting device (2) is eased, and generating of a crack can be suppressed.
[0011] A crevice (3a) is formed in one edge of the external terminal (3 4) of the couple which constitutes a base (3, 4, 11) from a form of operation of this invention. A semiconductor light emitting device (2) fixes on the base (3b) of a crevice (3a), and at l ast the electrode (2f, two g) of the couple of a semiconductor light emitting device (2) and one side of the aforementioned external terminal (3 4) are electrically connected to it by the bonding wire (5 6). The edge and bonding wir (5 6) of a coating material (10) and an external terminal (3 4) are covered with a covering object (8). A light-scattering agent (16) is the oxide, salt, or organic pigment containing one sort of silicon, aluminum, titanium, calcium, and barium, or two sorts or more.
[0012] A layered product (12) fixes through the adhesives (13 15) of a translucency to the principal plane of a s miconductor light emitting device (2) between a semiconductor light emitting device (2) and bases (3, 4, 11) or by the opposit side of a base (3, 4, 11). Moreover, a part of light [ at least ] irradiated from the semiconductor light emitting d vice (2) is absorbed, and the light of long wave length is emitted rather than this. A layered product (12) and a coating material (10) may also contain a fluorescent substance and a light-scattering agent (16).
[0013] A coating material (10) is the PORIME taro Korean geisha who has a translucency, a ceramic, or a resin, and is glass specially formed considering METARO Korean geisha (metaloxane) combination as a subject. It is formed under the surface layer (10a) in which the light-scattering agent (16) was mixed, and the surface layer (10a), the light-scattering agent (16) is not mixed, or a coating material (10) is equipped with an internal layer (10b) with few contents of a light-scattering agent (16) than a surface layer (10a). An internal layer (10b) covers the whole surface except the undersurface of a s miconductor light emitting device (2), and a surface layer (10a) covers a semiconductor light emitting device (2) through an internal layer (10b).
[0014] Project from the upper-limb section (3d) of a crevice (3a), and there is not a semiconductor light emitting device (2) or a lay red product (12). A semiconductor light emitting device (2) fixes at the bottom (3b) of a crevice (3a) through a lay red product (12) and adhesives (13 15) through adhesives (13). A semiconductor light emitting device (2) emits light by 365-550nm light wave length, and consists of a gallium-nitride system compound semiconductor light emitting device.
[0015] A semiconductor light emitting device (2) is fixed at the pars basilaris ossis occipitalis (3b) of a crevice (3a) through the fluorescence binder layer (12) containing the fluorescent substance which absorbs the light which it is mixed in the binder which has a translucency to the light irradiated from a semiconductor light emitting device (2), and a binder, and is irradiat d from a semiconductor light emitting device (2), and is changed into other luminescence wavelength.
[0016] A cr vice (3a) is formed in one principal plan of the insulating substrat (11) which constitut s a bas (3, 4, 11). A semiconductor light emitting device (2) fixes to a cr vic (3a), and the electrod (2f, two g) of th coupl of a semiconductor light emitting devic (2) is lectrically connect d to the xternal terminal (3 4) of the coupl mutually prolong d in opposite direction along with one principal plan of an insulating substrat (11).
[0017]
[Embodiments of the Invention] Her after, the g stalt of operation of th semiconduct r lumin scenc quipm nt by this invention is explain d about drawing 1 - drawing 6 .
[0018] As shown in drawing 1 , the light mitting diode quipment (1) by th g stalt of this peration Th first xt rnal t rminal (3) and th sec nd xternal terminal (4) which constitute a base, The light mitting diod chip which is th semiconductor light mitting devic which fix d to the crevic (3a) form d in the first xternal terminal (3) (2), It has th

closure r sin (8) of th covering object which cov rs the coating material (10) with which covers a light mitting diod chip (2), and a crevic (3a) is filled up, and a coating mat rial (10). Moreover, it has the light-scattering agent (16) ov r which the light which it was mixed th fluorescent substance chip (12) which constitutes the lay r d product of th translucency containing th fluorescent substanc which changes into other luminesc nc wav l ngth the light which it fix d on the upp r surface of a light mitting diode chip (2), and was irradiated from the light mitting diod chip (2), and into th coating material (10), and was irradiat d from the light emitting diode chip (2) is scatt red. A fluor sc nt substance chip (12) is th waf r of th solid-state constitut d by mixed inorganic material, such as a crystalline of th light-transmission nature c ntaining a fluoresc nt substance, a baking obj ct, and a resin, the mix d organic material, or th mix d inorganic organic material. By forming a fluor scent substanc chip (12) by th solid waf r, light mitting diode quipment can be manufactured easily.

[0019] A light emitting diode chip (2) consists of the gallium-nitride (GaN) system compound semiconductor made to emit light on the wavelength of 365-550nm. With the gestalt of this operation, the peak of luminescence wavelength uses th blu light emitting diode chip (2) of the GaN system which is about 440-470nm for a light emitting diode chip (2). A fluoresc nt substance chip (12) uses the single crystal or sintered compact of YAG (yellowish green light of luminescence wavel ngth (peak about 450nm of an yttrium aluminum garnet, chemical formula Y3aluminum 5O12, and excitation wav l ngth, and peak about 540nm)) which carried out optimum dose addition of the cerium as an activator. Thereby, sinc the luminescence wavelength of a light emitting diode chip (2) and the excitation wavelength of a YAG fluorescent substanc are mostly in agreement, wavelength conversion is performed efficiently. What is necessary is just to change a part of crystal structure of a YAG fluorescent substance, when shifting the emission spectrum distribution of a fluoresc nt substance chip (12) and adjusting luminescence of light emitting diode equipment (1) to a desired color tone further. For xample, if optimum dose addition of a gallium or/, and the lutetium is carried out, it will shift to a short wavelength sid , and if optimum dose addition of the gadolinium etc. is carried out, it will shift to a long wavelength side.

[0020] The inferior surface of tongue and the upper surface of a light emitting diode chip (2) fix through adhesives (13 15), r spectively on the base (3b) of a crevice (3a), and the inferior surface of tongue of a fluorescent substance chip (12). The adhesive resin containing inorganic material is used for adhesives (13 15). An epoxy resin or silicone resin is desirable, and the inorganic material mixed to an adhesive resin has silver, aluminum, titanium oxide, a desirable silica, etc. Moreover, if th adh siv s (13 15) which consist of PORIME taro Korean geisha or a ceramic are used, the optical absorption accompanying d gradation of an adhesive resin, discoloration, and degradation discoloration can be prevented.

[0021] The electrode (2f, two g) of a couple is connected to the upper surface of a light emitting diode chip (2), and a bonding wire (5 6) is electrically connected between an electrode (2f, two g) and the wire connection (9a, 9b) of the edg of an xt rnal terminal (3 4). Connection can be easily made by the well-known wirebonding method. The depth of a crevice (3a) is larger than the height which repeated the light emitting diode chip (2) and the fluorescent substance chip (12), and there is [ up project and ] no upper surface of a fluorescent substance chip (12) than the upper-limb section (3d) of a cr vice (3a). A crevice (3a) crushes the edge of the first external terminal (3) in the length direction, and is formed.

[0022] A crevice (3a) is filled up with a coating material (10) with the light emitting diode chip (2) and fluorescent substance chip (12) which have been arranged inside a crevice (3a). Coating materials (10) are resins, such as the PORIME taro Kor an g isha gel and the ceramic which have a translucency, or epoxy. PORIME taro Korean geisha gel has METARO Korean geisha combination, solidifies the PORIME taro Korean geisha sol which depolymerizes a metal alkoxide an added wat r part with a sol-gel method, and changes, and is formed. PORIME taro Korean geisha gel — an ultraviolet-rays-proof property — excelling — the bottom of hot environments or ultraviolet rays — substantial — yellowing - coloring is not produc d for this reason, yellowing which attenuates luminescence from a light emitting diode chip (2) whether the light of the short wavelength which produces a coating material (10) from a light emitting diode chip (2) is irradiated comparativ ly for a long time or a temperature rise arises in generation of heat by energization of a light emitting diode chip (2) - coloring does not occur

[0023] The light-scattering agent (16) which scatters the light irradiated from the light emitting diode chip (2) into a coating mat rial (10) is made to contain. A light-scattering agent (16) uses the oxide, salt, or organic pigment containing one sort of inorganic substances, such as silicon, aluminum, titanium, calcium, and barium, or two sorts or more. The coating material (10) containing a light-scattering agent (16) is formed by the dipping method flooded with the coating-material formation solution which distributed the dispenser applying method or light-scattering agent (16) which supplies the coating-material formation solution which distributed the light-scattering agent (16) in a crevice (3a) with an application machine (not shown) in a cr vice (3a). The edge and bonding wire (5 6) of a coating material (10) and an external terminal (3 4) are covered by th closure resin (8) which consists the lens section (8a) of an epoxy resin in preparation for a nose of cam. A closure r sin (8) is formed by the well-known potting method or the well-known transfermold method.

[0024] If voltage is impressed between the external terminals (3 4) of the light emitting diode equipment (1) shown in drawing 1 and a light emitting diode chip (2) is made to emit light, a part of light emitted from the light emitting diode chip (2) will b changed into the luminescence wavelength and different wavelength by the fluorescent substance of a fluoresc nt substance chip (12), and it will be emitted to the exterior of a fluorescent substance chip (12) with it. Wav length conversion of the light which, on the other hand, does not pass a fluorescent substance chip (12) with the light mitted from the light emitting diode chip (2) is not carried out. Since the light by which wavelength conversion is not carri d ut, and the light by which wav length conversion was carri d out collide with the light-scattering ag nt (16) mixed into th coating material (10) and is reflected irr gularly in th various dir ctions, in a crevic (3a), it is often mix d and interf res in it mutually. Th blue glow of a light mitting diode chip (2) and th yellow light of a fluorescent substanc chip (12) turn into th whit light by which color mixtur was carri d out, incid nce of th light mix d in th crevice (3a) is carri d out into a closure r sin (8), it is condens d in th lens s cti n (8a) f a closur r sin (8), without refl cting irregularly, and it is emitted to th xterior of light mitting diod quipm nt (1).

[0025] As m ntion d abov , sinc a light-scatt ring ag nt (16) d viates, th scatt r d light ccurs in a cr vic (3a), the scatt r d light is mix d and it int rfer s in th light mitting diode quipm nt (1) by this peration g stalt mutually when the light irradiat d from th light mitting diod chip (2) passes through th inside of a fluorescent substance chip (12) and a c ating mat rial (10), th amount of luminescenc is equalized ov r the whol luminesc nce sid surfac f a closure

r sin (8). Mor over, th light by which wavel ngth conv rsion was carried out and wavelength conversion was carri d out further, and th light by which wav l ngth conv rsion is not carri d out ar mixed, and it int rf res in th light which passes al ng a fluorescent substanc chip (12). for this r ason, th light mitt d to the coating-mat rial (10) shell xterior — dispersion and wavelength conv rsion — and sinc it is mixed and interf res, the luminescent color is qualized over th whole luminescenc sid surface of a closur r sin (8) Thus, since the quantity of light and the lumin scent color which are emitted from a closur r sin (8) are qualized, an irregular color can fully be suppressed. Since dispersion of light, wavelength conversion, mixtur , and interf r nce are p rformed in the crevic (3a) us d as a r flecting plate and a lot of light r flects by the inside of a cr vice (3a), the br adth of a light b am is suppress d, th quantity of light which go s to th lens s ction (8b) f a closure resin (8) increases, and cond nsing nature and dir ctivity can be improv d. Furth rmor , since a light-scattering agent (16) is mixed into a coating material (10), the coefficient of linear expansion of a coating material (10) approaches the coefficient of linear expansion of a light emitting diode chip (2). For this reason, the thermal xpansion of the coating material (10) by generation of heat at the time of lighting of a light emitting diode chip (2) and the coating material (10) by the coefficient-of-linear-expansion difference with a light emitting diode chip (2) is eased, and generating of a crack is suppressed.

[0026] The gestalt of the aforementioned implementation can be changed. For example, although the gestalt of the aforementioned implementation showed the light emitting diode equipment (1) which fixed the fluorescent substance chip (12) on the upper surface of a light emitting diode chip (2), as shown in drawing 2 , you may fix a fluorescent substance chip (12) b tween the inferior surface of tongue of a light emitting diode chip (2), and the base (3b) of a crevice (3a). Moreov r, as shown in drawing 3 , you may fix a light emitting diode chip (2) at the pars basilaris ossis occipitalis (3b) of a crevice (3a) through the fluorescence binder layer (12) containing the fluorescent substance which absorbs the light which it was mixed in the binder which has a translucency, and the binder, and was irradiated from the light emitting diode chip (2), and is chang d into other luminescence wavelength.

[0027] Although the gestalt of the aforementioned implementation showed the light emitting diode equipment (1) which made the coating material (10) distribute a light-scattering agent (16) uniformly The surface layer in which the light-scattering agent (16) was mixed as shown in drawing 4 (10a), It is formed under the surface layer (10a), and the coating material (10) which the light-scattering agent (16) is not mixed or consists of an internal layer (10b) with few contents of a light-scattering agent (16) than a surface layer (10a) may be formed. At this time, an internal layer (10b) covers the whole surface except the inferior surface of tongue of a light emitting diode chip (2), and a surface layer (10a) covers a light mitting diode chip (2) through an internal layer (10b).

[0028] Moreover, although the crevice (3a) is formed in the first external terminal (3) which constitutes a base with the gestalt of the aforementioned implementation, you may form a crevice (3a) in one principal plane of the insulating substrate (11) which constitutes a base. As shown in drawing 5 , a light emitting diode chip (2) fixes in a crevice (3a), and the l ctrode (2f, two g) of the couple of a light emitting diode chip (2) is electrically connected to the external terminal (3 4) of the couple mutually prolonged in opposite direction along with one principal plane of an insulating substrate (11) through a bonding wire (5 6). Moreover, as shown in drawing 6 , you may connect the electrode (2f, two g) of a couple to a direct xternal terminal (3 4), without minding a bonding wire (5 6).

[0029] The almost same operation effect as the gestalt of the operation which shows the gestalt of operation shown in drawing 2 - drawing 6 to drawing 1 is acquired. Moreover, even if it makes both a fluorescent substance chip (12), and both [ one side or ] (10) contain a fluorescent substance and a light-scattering agent (16), the almost same operation effect is acquired.

[0030]

[Effect of the Invention] In this invention, since a coating material is made to contain a light-scattering agent, it is uniform, luminesc nce without an irregular color is obtained, and directivity and the luminescence property that condensing nature is high and good are acquired. Moreover, the crack initiation of a coating material can be suppressed and reliable s miconductor luminescence equipment can be obtained.

---

[Translation done.]

* NOTICES *



1.This document has b en translated by comput r. So the translation may not r fl ct the original precisely.
2.**** shows the word which can not be translat d.
3.In th drawings, any words ar not translated.

## DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The cross section of the semiconductor luminescence equipment by this invention
[Drawing 2] The partial expanded sectional view by this invention showing the gestalt of the 2nd operation
[Drawing 3] The partial expanded sectional view by this invention showing the gestalt of the 3rd operation
[Drawing 4] The partial expanded sectional view by this invention showing the gestalt of the 4th operation
[Drawing 5] The partial expanded sectional view by this invention showing the gestalt of the 5th operation
[Drawing 6] The partial expanded sectional view by this invention showing the gestalt of the 6th operation
[Drawing 7] The cross section of conventional semiconductor luminescence equipment
[Drawing 8] The partial expanded sectional view of the semiconductor luminescence equipment of drawing 7
[Drawing 9] The plan showing the state where the semiconductor luminescence equipment of drawing 7 was made to turn on
[Description of Notations]
(1) .. Semiconductor luminescence equipment (light emitting diode equipment) (2) .. Semiconductor light emitting device (light mitting diode chip), (2f, two g) .. Electrode (3 4) .. External terminal (3a) .. Crevice, (3b) .. Pars basilaris ossis occipitalis (3c) .. Side attachment wall (3d) .. Upper-limb section, (5 6) .. Bonding wire (8) .. Covering object (closure resin), (9a, 9b) .. Wire connection (10) .. Coating material, (10a) .. Surface layer (10b) .. [ (12) .. Layered product (fluorescent substance chip) (13 15) .. Adhesives (16) .. Light-scattering agent, ] An internal layer, (11) .. Insulating substrate

[Translation done.]

(19)日本国特許庁(JP)　(12)公開特許公報（A）　(11)特許出願公開番号

特開２００１－８５７４７

（Ｐ２００１－８５７４７Ａ）

(43)公開日　平成13年3月30日(2001.3.30)

| (51)Int.Cl.⁷ | 識別記号 | FI | | テーマコード(参考) |
|---|---|---|---|---|
| Ｈ０１Ｌ | 33/00 | Ｈ０１Ｌ | 33/00 | Ｎ 4J038 |
| | | | | Ｃ 4J040 |
| Ｃ０９Ｄ | 1/00 | Ｃ０９Ｄ | 1/00 | 4M109 |
| | 7/12 | | 7/12 | Ｚ 5F041 |
| | 201/00 | | 201/00 | |

審査請求　有　請求項の数１８　ＯＬ　（全８頁）　最終頁に続く

(21)出願番号　特願平11-258381

(22)出願日　平成11年9月13日(1999.9.13)

(71)出願人　000106276
サンケン電気株式会社
埼玉県新座市北野3丁目6番3号

(72)発明者　佐野　武志
埼玉県新座市北野3丁目6番3号　サンケン電気株式会社内

(72)発明者　白石　旭
埼玉県新座市北野3丁目6番3号　サンケン電気株式会社内

(74)代理人　100082049
弁理士　清水　敬一

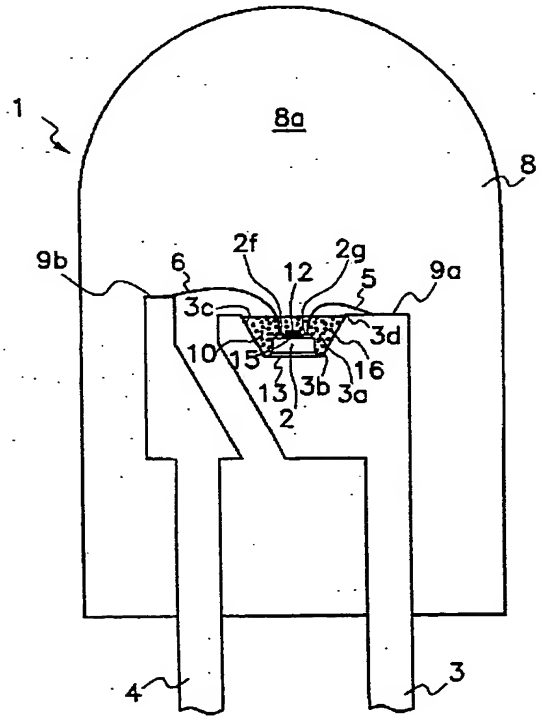
最終頁に続く

(54)【発明の名称】半導体発光装置

(57)【要約】

【課題】　半導体装置の色むらの発生を防止し、光の指向性を高める。

【解決手段】　基体(3, 4, 11)と、基体(3, 4, 11)に形成された凹部(3a)に固着された半導体発光素子(2)と、半導体発光素子(2)を被覆し且つ凹部(3a)に充填されるコーティング材(10)と、コーティング材(10)を被覆する被覆体(8)とを備え、半導体発光素子(2)から照射された光を他の発光波長に変換する蛍光物質を含む透光性の積層体(12)を半導体発光素子(2)の上面又は下面に固着し、半導体発光素子(2)から照射された光を散乱させる光散乱剤(16)をコーティング材(10)中に混入する。これにより、色むらが無く指向性の高い発光が得られると共に、クラック発生を抑制する。



1

【特許請求の範囲】

【請求項１】　基体と、該基体に形成された凹部に固着された半導体発光素子と、該半導体発光素子を被覆し且つ前記凹部に充填されるコーティング材と、該コーティング材を被覆する被覆体とを備える半導体発光装置において、

前記半導体発光素子から照射された光を他の発光波長に変換する蛍光物質を含む透光性の積層体を前記半導体発光素子の上面又は下面に固着し、

前記半導体発光素子から照射された光を散乱させる光散乱剤を前記コーティング材中に混入したことを特徴とする半導体発光装置。

【請求項２】　前記基体を構成する一対の外部端子の一方の端部に凹部が形成され、該凹部の底面に前記半導体発光素子が固着され、該半導体発光素子の一対の電極と前記一対の外部端子の少なくとも一方とがボンディングワイヤで電気的に接続された請求項１に記載の半導体発光装置。

【請求項３】　前記コーティング材、外部端子の端部及びボンディングワイヤを前記被覆体により被覆する請求項１又は２に記載の半導体発光装置。

【請求項４】　前記光散乱剤は、珪素、アルミニウム、チタン、カルシウム及びバリウムの１種又は２種以上を含む酸化物若しくは塩又は有機顔料である請求項１～３の何れか１項に記載の半導体発光装置。

【請求項５】　前記積層体は、前記半導体発光素子と前記基体との間又は前記基体の反対側で前記半導体発光素子の主面に透光性の接着剤を介して固着された請求項１～４の何れか１項に記載の半導体発光装置。

【請求項６】　前記積層体は、前記半導体発光素子から照射された光の少なくとも一部を吸収し、これよりも長い波長の光を放出する請求項１～５の何れか１項に記載の半導体発光装置。

【請求項７】　前記積層体は前記蛍光物質及び光散乱剤を含む請求項１～６の何れか１項に記載の半導体発光装置。

【請求項８】　前記コーティング材は前記光散乱剤及び蛍光物質を含む請求項１～７の何れか１項に記載の半導体発光装置。

【請求項９】　前記コーティング材は、透光性を有するポリメタロキサン、セラミック又は樹脂である請求項１～８の何れか１項に記載の半導体発光装置。

【請求項１０】　前記コーティング材は、メタロキサン（metaloxane）結合を主体として形成されたガラスである請求項９に記載の半導体発光装置。

【請求項１１】　前記コーティング材は、前記光散乱剤が混入された表面層と、該表面層の下方に形成され且つ前記光散乱剤が混入されていないか又は前記表面層より前記光散乱剤の含有量が少ない内部層とを備える請求項１～１０の何れか１項に記載の半導体発光装置。

2

【請求項１２】　前記コーティング材の前記内部層は、前記半導体発光素子の下面を除く全面を被覆し、前記表面層は前記内部層を介して前記半導体発光素子を被覆する請求項１１に記載の半導体発光装置。

【請求項１３】　前記半導体発光素子又は積層体は、前記凹部の上縁部から突出しない請求項１～１２の何れか１項に記載の半導体発光装置。

【請求項１４】　前記半導体発光素子は、前記接着剤を介して又は前記積層体及び接着剤を介して前記凹部の底部に固着される請求項１～１３の何れか１項に記載の半導体発光装置。

【請求項１５】　前記半導体発光素子は、３６５～５５０nmの光波長で発光する請求項１～１４の何れか１項に記載の半導体発光装置。

【請求項１６】　前記半導体発光素子は、窒化ガリウム系化合物半導体発光素子から成る請求項１～１５の何れか１項に記載の半導体発光装置。

【請求項１７】　前記半導体発光素子から照射される光に対して透光性を有するバインダと該バインダ内に混合され且つ前記半導体発光素子から照射される光を吸収して他の発光波長に変換する蛍光物質とを含む蛍光バインダ層を介して、前記半導体発光素子を前記凹部の底部に固着する請求項１～１６の何れか１項に記載の半導体発光装置。

【請求項１８】　前記基体を構成する絶縁性基板の一方の主面に凹部が形成され、該凹部に前記半導体発光素子が固着され、前記半導体発光素子の一対の電極は、前記絶縁性基板の一方の主面に沿って互いに反対方向に延びる一対の外部端子に電気的に接続された請求項１に記載の半導体発光装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、半導体発光素子からの発光を蛍光物質によって波長変換させて装置外部に取り出す半導体発光装置、詳細には色むらを防止し光の指向性を向上できる半導体発光装置に属する。

【０００２】

【従来の技術】例えば、窒化ガリウム系化合物半導体等の発光素子を被覆する被覆体（封止樹脂）中に蛍光物質を含む積層体を形成し、発光素子から放射される光の波長が積層体によって変換され、異なる波長の光を外部に放出する半導体発光装置は公知である。

【０００３】図７は、ダイオードチップ(2)から照射される光の波長を発光ダイオードチップ(2)の上面に形成された積層体の蛍光体チップ(12)によって変換する従来の発光ダイオード装置(20)の断面図を示す。図７に示す発光ダイオード装置(20)では、一方の端部側に凹部（皿形状の電極）(3a)及び第一のワイヤ接続部(9a)が形成されたカソード側リードとしての第一の外部端子(3)と、他の一方の端部側に第二のワイヤ接続部(9b)が形成され

たアノード側リードとしての第二の外部端子(4)と、接着剤(13)により凹部(3a)の底面(3b)に固着された発光ダイオードチップ(2)と、発光ダイオードチップ(2)の上面に接着剤(15)を介して固着された蛍光体チップ(12)と、発光ダイオードチップ(2)に固着されたカソード電極(2g)及びアノード電極(2f)と第一のワイヤ接続部(9a)及び第二のワイヤ接続部(9b)との間に電気的に接続された第一のボンディングワイヤ(5)及び第二のボンディングワイヤ(6)とを備える。また、蛍光体チップ(12)及び発光ダイオードチップ(2)が配置された凹部(3a)、外部端子(3, 4)の端部及びボンディングワイヤ(5, 6)は、透光性の封止樹脂(8)内に封入され、封止樹脂(8)の先端にはレンズ部(8a)を備えるので、封止樹脂(8)内を通過する光がレンズ部(8a)によって集光されて指向性が高められる。

【０００４】発光ダイオード装置(20)の外部端子(3, 4)間に電圧を印加して発光ダイオードチップ(2)に通電すると、発光ダイオードチップ(2)から光が照射される。照射された光の内、発光ダイオードチップ(2)の上方向に放出された光は、透光性の接着剤(15)を介して蛍光体チップ(12)に達し、波長変換されて異なった波長の光となった後に蛍光体チップ(12)から放出される。この波長変換された光は、発光ダイオードチップ(2)の横方向に放出された波長変換されない光及び横方向に放出され凹部(3a)の側壁(3c)で反射した波長変換されない光と混合して、封止樹脂(8)を通して発光ダイオード装置(20)の外部に放出される。

【０００５】

【発明が解決しようとする課題】図７に示す発光ダイオード装置(20)は、前記のように発光ダイオードチップ(2)から照射されて蛍光体チップ(12)を介して異なる発光波長に変換された光と、発光ダイオードチップ(2)から照射されて蛍光体チップ(12)を介さずに波長変換されない光との混合された光が発光ダイオード装置(20)の外部に放出される。このとき、実際には、波長変換された光と波長変換されない光とが完全に混合されず、外部に放出される光に色むらが生じて色合いが不均一になる。

【０００６】図８は、発光素子として窒化ガリウム系(GaN)系青色発光ダイオードチップ(2)を使用し、蛍光物質としてYAG（イットリウム・アルミニウム・ガーネット、化学式$Y_3Al_5O_{12}$）蛍光体チップ(12)を使用して白色光を発生する発光ダイオード装置（白色発光ダイオード）(20)の色むらを模式的に示す。図８に示すように、発光ダイオードチップ(2)の上面から放出された光は蛍光体チップ(12)によって十分に波長変換されて白色又は黄色に近い色に観測される。一方、発光ダイオードチップ(2)の側面から放出された光は、蛍光体チップ(12)による波長変換が不十分で青色に観測される。このため、上方からみると、図９に示すように、黄色又は白色気味の中央と青色気味のリング状の外周との光の色むらが発生する。

【０００７】また、前記発光ダイオード装置(20)の封止樹脂(8)に光散乱剤を混入することにより、波長変換された光と波長変換されない光とを封止樹脂(8)内で混合して、色むらを防止することができる。しかしながら、封止樹脂(8)に光散乱剤を混入すると、凹部(3a)から放出された光が封止樹脂(8)内で光散乱剤に衝突して乱反射するので、発光ダイオード装置(20)の先端のレンズ部(8a)で完全に集光されず、光の指向角は大きくなり指向性が低下する。

【０００８】本発明は、色むらの発生を防止する半導体発光装置を提供することを目的とする。また、光の指向性を高める半導体発光装置を提供することを目的とする。また、半導体発光素子を被覆するコーティング材の熱膨張によるクラック発生を抑制することを目的とする。更に、半導体発光素子に加わる応力を低減し、半導体発光素子の劣化を防ぐことを目的とする。

【０００９】

【課題を解決するための手段】本発明による半導体発光装置は、基体(3, 4, 11)と、基体(3, 4, 11)に形成された凹部(3a)に固着された半導体発光素子(2)と、半導体発光素子(2)を被覆し且つ凹部(3a)に充填されるコーティング材(10)と、コーティング材(10)を被覆する被覆体(8)とを備える。半導体発光素子(2)から照射された光を他の発光波長に変換する蛍光物質を含む透光性の積層体(12)を半導体発光素子(2)の上面又は下面に固着し、半導体発光素子(2)から照射された光を散乱させる光散乱剤(16)をコーティング材(10)中に混入する。

【００１０】半導体発光素子(2)から照射された光が積層体(12)及びコーティング材(10)内を通過するとき、光散乱剤(16)により種々の方向に偏向され凹部(3a)内で散乱光が発生し、散乱光は混合され互いに干渉するので、被覆体(8)の発光面全面にわたり発光量が均一化される。また、光の散乱に加えて、蛍光物質を含む積層体(12)を通る光は波長変換され、更に波長変換された光と波長変換されない光とが混合され且つ干渉する。このため、コーティング材(10)から外部に放出される光は、散乱、波長変換及び混合され且つ干渉するので、被覆体(8)の発光面全面にわたり発光色が均一化される。このように、被覆体(8)から放出される光量及び発光色が均一化されるので、色むらを十分に抑制することができる。光の散乱、波長変換、混合及び干渉は、反射板となる凹部(3a)内で行われ、多量の光が凹部(3a)の内面で反射するので、光ビームの広がりが抑制され、被覆体(8)の頂部に向かう光量が増加して、集光性及び指向性を向上できる。更に、コーティング材(10)中に光散乱剤(16)を混入するので、コーティング材(10)の線膨張係数が半導体発光素子(2)の線膨張係数に近づく。このため、半導体発光素子(2)の点灯時の発熱によるコーティング材(10)と半導体発光素子(2)との線膨張係数差によるコー

ティング材(10)の熱膨張が緩和され、クラックの発生を抑制することができる。

【００１１】本発明の実施の形態では、基体(3, 4, 11)を構成する一対の外部端子(3, 4)の一方の端部に凹部(3a)が形成され、凹部(3a)の底面(3b)に半導体発光素子(2)が固着され、半導体発光素子(2)の一対の電極(2f, 2g)と前記外部端子(3, 4)の少なくとも一方とがボンディングワイヤ(5, 6)で電気的に接続される。コーティング材(10)、外部端子(3, 4)の端部及びボンディングワイヤ(5, 6)は被覆体(8)により被覆される。光散乱剤(16)は、珪素、アルミニウム、チタン、カルシウム及びバリウムの１種又は２種以上を含む酸化物若しくは塩又は有機顔料である。

【００１２】積層体(12)は、半導体発光素子(2)と基体(3, 4, 11)との間又は基体(3, 4, 11)の反対側で半導体発光素子(2)の主面に透光性の接着剤(13, 15)を介して固着される。また、半導体発光素子(2)から照射された光の少なくとも一部を吸収し、これよりも長い波長の光を放出する。積層体(12)及びコーティング材(10)は蛍光物質及び光散乱剤(16)を含んでもよい。

【００１３】コーティング材(10)は、透光性を有するポリメタロキサン、セラミック又は樹脂であり、特に、メタロキサン（metaloxane）結合を主体として形成されたガラスである。コーティング材(10)は、光散乱剤(16)が混入された表面層(10a)と、表面層(10a)の下方に形成され且つ光散乱剤(16)が混入されていないか又は表面層(10a)より光散乱剤(16)の含有量が少ない内部層(10b)とを備える。内部層(10b)は、半導体発光素子(2)の下面を除く全面を被覆し、表面層(10a)は内部層(10b)を介して半導体発光素子(2)を被覆する。

【００１４】半導体発光素子(2)又は積層体(12)は、凹部(3a)の上縁部(3d)から突出しない。半導体発光素子(2)は、接着剤(13)を介して又は積層体(12)及び接着剤(13, 15)を介して凹部(3a)の底部(3b)に固着される。半導体発光素子(2)は、３６５～５５０nmの光波長で発光し、窒化ガリウム系化合物半導体発光素子から成る。

【００１５】半導体発光素子(2)から照射される光に対して透光性を有するバインダとバインダ内に混合され且つ半導体発光素子(2)から照射される光を吸収して他の発光波長に変換する蛍光物質とを含む蛍光バインダ層(12)を介して、半導体発光素子(2)を凹部(3a)の底部(3b)に固着する。

【００１６】基体(3, 4, 11)を構成する絶縁性基板(11)の一方の主面に凹部(3a)が形成され、凹部(3a)に半導体発光素子(2)が固着され、半導体発光素子(2)の一対の電極(2f, 2g)は、絶縁性基板(11)の一方の主面に沿って互いに反対方向に延びる一対の外部端子(3, 4)に電気的に接続される。

【００１７】

【発明の実施の形態】以下、本発明による半導体発光装置の実施の形態を図１～図６について説明する。

【００１８】図１に示すように、本実施の形態による発光ダイオード装置(1)は、基体を構成する第一の外部端子(3)及び第二の外部端子(4)と、第一の外部端子(3)に形成された凹部(3a)に固着された半導体発光素子である発光ダイオードチップ(2)と、発光ダイオードチップ(2)を被覆し且つ凹部(3a)に充填されるコーティング材(10)と、コーティング材(10)を被覆する被覆体の封止樹脂(8)とを備える。また、発光ダイオードチップ(2)の上面に固着され且つ発光ダイオードチップ(2)から照射された光を他の発光波長に変換する蛍光物質を含む透光性の積層体を構成する蛍光体チップ(12)と、コーティング材(10)中に混入され且つ発光ダイオードチップ(2)から照射された光を散乱させる光散乱剤(16)とを有する。蛍光体チップ(12)は蛍光物質を含む光透過性の結晶体、焼成体、樹脂等の混合無機材料、混合有機材料又は混合無機有機材料によって構成された固体の小片である。蛍光体チップ(12)を固体の小片で形成することにより、発光ダイオード装置を容易に製造することができる。

【００１９】発光ダイオードチップ(2)は３６５～５５０nmの波長で発光させる窒化ガリウム（GaN）系化合物半導体から成る。本実施の形態では、発光ダイオードチップ(2)に発光波長のピークが約４４０～４７０nmのGaN系の青色発光ダイオードチップ(2)を使用する。蛍光体チップ(12)は付活剤としてセリウムを適量添加したYAG（イットリウム・アルミニウム・ガーネット、化学式$Y_3Al_5O_{12}$、励起波長のピーク約４５０nm、発光波長のピーク約５４０nmの黄緑色光）の単結晶又は焼結体を使用する。これにより、発光ダイオードチップ(2)の発光波長とYAG蛍光体の励起波長とがほぼ一致するため効率良く波長変換が行なわれる。蛍光体チップ(12)の発光スペクトル分布をシフトさせて発光ダイオード装置(1)の発光を更に所望の色調に調整するときは、YAG蛍光体の結晶構造を一部変更すればよい。例えばガリウム又は／及びルテチウムを適量添加すれば短波長側にシフトし、ガドリニウム等を適量添加すれば長波長側にシフトする。

【００２０】発光ダイオードチップ(2)の下面及び上面は、接着剤(13, 15)を介して凹部(3a)の底面(3b)及び蛍光体チップ(12)の下面にそれぞれ固着される。接着剤(13, 15)は、無機材料を含有する接着性樹脂を使用する。エポキシ樹脂又はシリコーン樹脂が好ましく、接着性樹脂に混合する無機材料は、銀、アルミニウム、酸化チタン、シリカ等が好ましい。また、ポリメタロキサン又はセラミックから成る接着剤(13, 15)を使用すれば、接着性樹脂の劣化、変色及び劣化変色に伴う光吸収を防止できる。

【００２１】発光ダイオードチップ(2)の上面には一対の電極(2f, 2g)が接続され、電極(2f, 2g)と外部端子(3, 4)の端部のワイヤ接続部(9a, 9b)との間に、ボンディングワイヤ(5, 6)が電気的に接続される。接続は周知

のワイヤボンディング法により容易に行うことができる。凹部(3a)の深さは、発光ダイオードチップ(2)と蛍光体チップ(12)とを重ねた高さよりも大きく、蛍光体チップ(12)の上面は凹部(3a)の上縁部(3d)より上方には突出しない。凹部(3a)は、第一の外部端子(3)の端部を長さ方向に押し潰して形成される。

【００２２】凹部(3a)の内側に配置された発光ダイオードチップ(2)と蛍光体チップ(12)と共に、凹部(3a)にはコーティング材(10)が充填される。コーティング材(10)は、透光性を有するポリメタロキサンゲル、セラミック又はエポキシ等の樹脂である。ポリメタロキサンゲルはメタロキサン結合を有し、金属アルコキシドをゾル・ゲル法により加水分解重合して成るポリメタロキサンゾルを固化して形成される。ポリメタロキサンゲルは、耐紫外線特性に優れ高温環境下又は紫外線下でも実質的に黄変・着色を生じない。このため、コーティング材(10)は、発光ダイオードチップ(2)から生ずる短波長の光が比較的長時間照射されても、また発光ダイオードチップ(2)の通電による発熱で温度上昇が生じても、発光ダイオードチップ(2)からの発光を減衰させる黄変・着色が発生しない。

【００２３】コーティング材(10)中には、発光ダイオードチップ(2)から照射された光を散乱させる光散乱剤(16)を含有させる。光散乱剤(16)は、珪素、アルミニウム、チタン、カルシウム及びバリウム等の無機物の１種又は２種以上を含む酸化物若しくは塩又は有機顔料を使用する。光散乱剤(16)を含むコーティング材(10)は、光散乱剤(16)を分散させたコーティング材形成溶液を塗布機（図示せず）で凹部(3a)内に供給するディスペンサ塗布法又は光散乱剤(16)を分散させたコーティング材形成溶液に凹部(3a)を浸漬するディップ法により形成される。コーティング材(10)、外部端子(3，4)の端部及びボンディングワイヤ(5，6)は、先端にレンズ部(8a)を備え且つエポキシ樹脂からなる封止樹脂(8)に被覆される。封止樹脂(8)は周知のポッティング法又はトランスファモールド法により形成される。

【００２４】図１に示す発光ダイオード装置(1)の外部端子(3，4)間に電圧を印加して発光ダイオードチップ(2)を発光させると、発光ダイオードチップ(2)から放出された光の一部は、蛍光体チップ(12)の蛍光物質によってその発光波長と異なる波長に変換され、蛍光体チップ(12)の外部に放出される。一方、発光ダイオードチップ(2)から放出された光で蛍光体チップ(12)を通過しない光は、波長変換されない。波長変換されない光と波長変換された光とは、コーティング材(10)中に混入された光散乱剤(16)に衝突して種々の方向に乱反射するので、凹部(3a)内でよく混合され互いに干渉する。凹部(3a)内で混合された光は、発光ダイオードチップ(2)の青色光と蛍光体チップ(12)の黄色光とが混色された白色光となり、封止樹脂(8)内に入射され、乱反射せずに封止樹脂(8)のレンズ部(8a)で集光されて発光ダイオード装置(1)の外部に放出される。

【００２５】以上より、本実施形態による発光ダイオード装置(1)は、発光ダイオードチップ(2)から照射された光が蛍光体チップ(12)及びコーティング材(10)内を通過するとき、光散乱剤(16)により偏向され凹部(3a)内で散乱光が発生し、散乱光は混合され互いに干渉するので、封止樹脂(8)の発光面全面にわたり発光量が均一化される。また、蛍光体チップ(12)を通る光は波長変換され、更に波長変換された光と波長変換されない光とが混合され且つ干渉する。このため、コーティング材(10)から外部に放出される光は、散乱、波長変換及び混合され且つ干渉するので、封止樹脂(8)の発光面全面にわたり発光色が均一化される。このように、封止樹脂(8)から放出される光量及び発光色が均一化されるので、色むらを十分に抑制できる。光の散乱、波長変換、混合及び干渉は、反射板となる凹部(3a)内で行われ、多量の光が凹部(3a)の内面で反射するので、光ビームの広がりが抑制され、封止樹脂(8)のレンズ部(8b)に向かう光量が増加して、集光性及び指向性を向上できる。更に、コーティング材(10)中に光散乱剤(16)を混入するので、コーティング材(10)の線膨張係数が発光ダイオードチップ(2)の線膨張係数に近づく。このため、発光ダイオードチップ(2)の点灯時の発熱によるコーティング材(10)と発光ダイオードチップ(2)との線膨張係数差によるコーティング材(10)の熱膨張が緩和され、クラックの発生を抑制する。

【００２６】前記実施の形態は変更が可能である。例えば、前記実施の形態では、発光ダイオードチップ(2)の上面に蛍光体チップ(12)を固着した発光ダイオード装置(1)を示したが、図２に示すように、発光ダイオードチップ(2)の下面と凹部(3a)の底面(3b)との間に蛍光体チップ(12)を固着してもよい。また、図３に示すように、透光性を有するバインダとバインダ内に混合され且つ発光ダイオードチップ(2)から照射された光を吸収して他の発光波長に変換する蛍光物質とを含む蛍光バインダ層(12)を介して、発光ダイオードチップ(2)を凹部(3a)の底部(3b)に固着してもよい。

【００２７】前記実施の形態では光散乱剤(16)をコーティング材(10)に均一に分散させた発光ダイオード装置(1)を示したが、図４に示すように、光散乱剤(16)が混入された表面層(10a)と、表面層(10a)の下方に形成され且つ光散乱剤(16)が混入されていないか又は表面層(10a)より光散乱剤(16)の含有量が少ない内部層(10b)とから成るコーティング材(10)を形成してもよい。このとき、内部層(10b)は、発光ダイオードチップ(2)の下面を除く全面を被覆し、表面層(10a)は内部層(10b)を介して発光ダイオードチップ(2)を被覆する。

【００２８】また、前記実施の形態では、基体を構成する第一の外部端子(3)に凹部(3a)が形成されているが、

9

基体を構成する絶縁性基板(11)の一方の主面に凹部(3a)を形成してもよい。図５に示すように、凹部(3a)には発光ダイオードチップ(2)が固着され、発光ダイオードチップ(2)の一対の電極(2f，2g)は、絶縁性基板(11)の一方の主面に沿って互いに反対方向に延びる一対の外部端子(3，4)にボンディングワイヤ(5，6)を介して電気的に接続される。また、図６に示すように、ボンディングワイヤ(5，6)を介さずに一対の電極(2f，2g)を直接外部端子(3，4)に接続してもよい。

【００２９】図２～図６に示す実施の形態は、図１に示す実施の形態とほぼ同一の作用効果が得られる。また、蛍光物質と光散乱剤(16)とを蛍光体チップ(12)及びコーティング材(10)の一方又は両方に含有させてもほぼ同一の作用効果が得られる。

【００３０】

【発明の効果】本発明では、コーティング材に光散乱剤を含有させるので、均一で色むらの無い発光が得られ、指向性及び集光性が高く良好な発光特性が得られる。また、コーティング材のクラック発生を抑制して、信頼性の高い半導体発光装置を得ることができる。

【図面の簡単な説明】

【図１】　本発明による半導体発光装置の断面図

【図２】　本発明による第２の実施の形態を示す部分拡大断面図

10

【図３】　本発明による第３の実施の形態を示す部分拡大断面図

【図４】　本発明による第４の実施の形態を示す部分拡大断面図

【図５】　本発明による第５の実施の形態を示す部分拡大断面図

【図６】　本発明による第６の実施の形態を示す部分拡大断面図

【図７】　従来の半導体発光装置の断面図

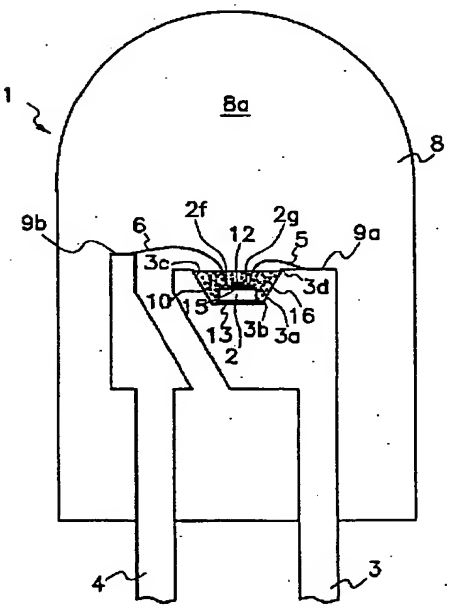
【図８】　図７の半導体発光装置の部分拡大断面図

【図９】　図７の半導体発光装置を点灯させた状態を示す平面図

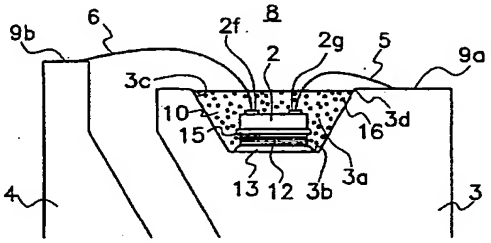
【符号の説明】

(1)・・半導体発光装置（発光ダイオード装置）、　(2)・・半導体発光素子（発光ダイオードチップ）、　(2f，2g)・・電極、　(3，4)・・外部端子、　(3a)・・凹部、　(3b)・・底部、　(3c)・・側壁、　(3d)・・上縁部、　(5，6)・・ボンディングワイヤ、　(8)・・被覆体（封止樹脂）、　(9a，9b)・・ワイヤ接続部、　(10)・・コーティング材、　(10a)・・表面層、　(10b)・・内部層、(11)・・絶縁性基板、　(12)・・積層体（蛍光体チップ）、　(13，15)・・接着剤、　(16)・・光散乱剤、

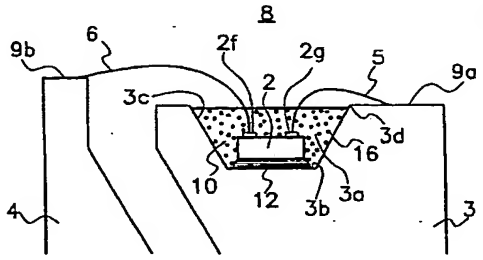
【図１】



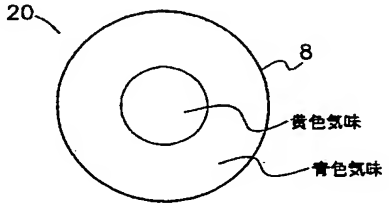

【図２】



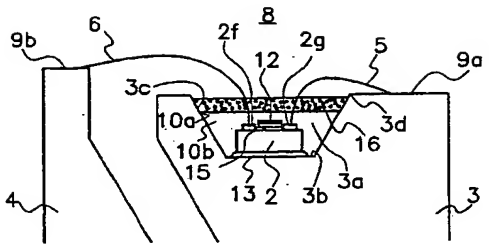

【図３】



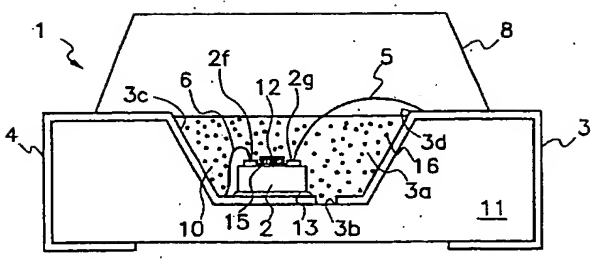

【図９】



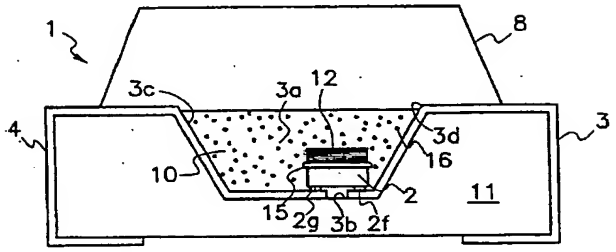
【図４】



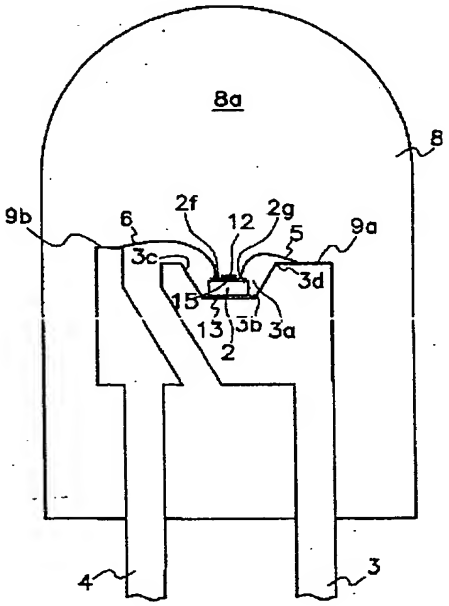

【図５】



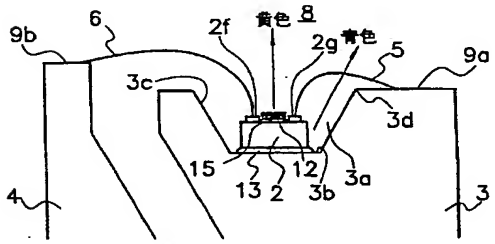

【図６】




【図７】




【図８】




フロントページの続き

| (51) Int. Cl.⁷ | 識別記号 | F I | テーマコード（参考） |
|---|---|---|---|
| Ｃ０９Ｊ　11/00 | | Ｃ０９Ｊ　11/00 | |
| 201/00 | | 201/00 | |
| Ｈ０１Ｌ　23/29 | | Ｈ０１Ｌ　23/30 | Ｆ |
| 23/31 | | | Ｂ |

Ｆターム(参考) 4J038 AA011 HA206 HA216 HA306
HA446 HA481 HA561 KA08
KA12 NA01 NA03 NA17 NA19
PB09
4J040 EC001 EK031 HA066 HA136
HA306 KA35 KA42 LA07
LA10 NA17 NA20
4M109 AA02 BA01 BA03 CA05 CA07
CA21 EA02 EC11 ED02 ED05
EE12 EE15 GA01
5F041 AA06 AA14 CA40 DA07 DA43
DA46 DA47 EE25